SECTION 2

STRATEGIC TERMINALS

2.0 Strategic Terminals

Strategic terminals are large node centers that provide gateway entry capabilities for tactical terminals, central hubs to terminate and process traffic through the Defense Information System Network (DISN), and host the Radio Frequency (RF) control capabilities for those terminals collocated with the DSCSOCs. Strategic terminals in this section include the AN/FSC-78B and AN/FSC-79B Heavy Terminals (HT); the AN/GSC-39B and AN/GSC-52 Medium Terminals (MT); and the AN/SCT-20, AN/SCT-35, and AN/TSC-86 Light Terminals.

The AN/FSC-78B, AN/GSC-39B, and AN/GSC-52 are the standard entry point and control terminals found at the DSCSOCs. The AN/FSC-79B terminals that were previously used to provide the SHF link for the Fleet Satellite Communications (FLTSATCOM) Satellite System and support for the Navy's Fleet Broadcast Network are no longer required to support this mission. The AN/FSC-79Bs are either being removed or converted to AN/FSC-78Bs for strategic Joint use. The AN/SCT-20 is a Special Departmental User (DEPUS) terminal used by the intelligence community. The AN/TSC-86 is primarily used in support of JCS contingency operations and is being upgrade with AN/GSC-52-like state-of-the-art technology comparable to the HT/MT modification upgrades. The following discussion describes each system in detail.

2.1 AN/FSC-78B, Heavy Terminal

2.1.1 General

The AN/FSC-78B is a fixed SHF SATCOM heavy terminal capable of transmitting and receiving signals simultaneously. Its design includes monitor capability, subsystem redundancy with automatic switchover, and automatic fault isolation. The terminal is composed of six subsystems: antenna tracking servo, transmitter, receiver, frequency generation, control, and monitoring. The antenna is a 60-foot diameter, high-efficiency parabolic reflector mounted on an elevation over azimuth-configured pedestal. The antenna terminal equipment has a tracking downconverter, 32 communication downconverters, and 24 communication upconverters. The output signals from the upconverters are combined into a composite signal that supplies four 2 kilowatt (kw) Traveling Wave Tube Amplifiers (TWTA). Normal operation involves combining two TWTA outputs providing a radiated antenna signal of 500 MHz bandwidth at an Effective Isotropic Radiated Power (EIRP) of 125 dBm. All four 2 kW power amplifiers can be operated simultaneously to provide an output equivalent to 8 kW minus the equipment insertion loss at an EIRP of 127 dBm.

The downconverters translate the receive signal of 7.25 to 7.75 GHz to 70 MHz Intermediate Frequency (IF) (40 MHz bandwidth) or a 700 MHz IF (125 MHz bandwidth). The upconverters translate the 70 or 700 MHz IF input signal into a RF transmit frequency of 7.9 to 8.4 GHz. The AN/FSC-78B is a standard DSCS HT used worldwide at major nodal communications centers. The terminal achieves a high degree of operational availability due to its complement of redundant equipment.

Figure 2-1 AN/FSC-78B

2.1.2 Antenna Subsystem

The antenna is a cassegrain feed horn system configured with a 60-foot main reflector, a 7-foot subreflector, and a five-horn monopulse feed system. The antenna main reflector has a parabolic surface. The circular subreflector, which has a contoured surface, is located 18 feet above the feed horn and is supported by a quadripod assembly. The pedestal is constructed as a standard yoke/king post elevation over azimuth design. The equipment room is located behind the antenna feed inside the elevation wheel. The antenna servo and control system uses dual drive motor, antibacklash systems on the azimuth and elevation axis.

2.1.3 Receiver Subsystem

The downlink signal is routed to a switch via waveguide and then to the appropriate Low Noise Amplifier (LNA). The LNA provides 70 dB amplification of the composite 7.25 to 7.75 GHz downlink signal. The LNA is adjustable over a 15 dB range by a variable attenuator. The Transmit and Receive Interface Control (TRIC) controls the on-/off-line LNA status by controlling the dual waveguide/coax switch. Status fault signals are sent to the TRIC. The on-line signal is routed to the signal divider, and the off-line signal is routed to the Measurement Switching-Translation Assembly (MSTA).

The signal distribution assembly contains a coax switch and summing network. The coax switch routes the test pilot signal either to the off-line LNA or to the summing network to be injected into the downlink system in the antenna feed. The summing network is a part of the calibration loop in host terminals and at the DSCSOCs. This network is used to send both the test pilot signal and DSCS Automatic Spectrum Analyzer (DASA) RF signal into the downlink signal path at the antenna feed or either of the two signals separately in terminals co-located with DSCSOC. The Frequency and Measurement Interface Controller (FMIC) provides control of the distribution assembly coax switch position. It also communicates with the switching assembly for switch positioning, status, and monitoring for testing. There is a power meter located in the Elevated Equipment Room (EER) connected to a directional coupler, via a 20 dB attenuator in the transmit feed. The power meter measures a sample of the transmit RF signal and routes this measurement back to the feed power monitor located in the terminal. The Frequency Conversion Group (FCG) (downlink) contains signal divider assemblies, downconverters, Downconverter Switching Assemblies (DSA), and a 5 MHz distribution amplifier. The receive signal divider assembly is a power divider that splits the RF downlink signal into eight separate outputs and feeds the RF downlink signal to the downconverter racks. Four of its outputs feed the downconverter racks; one is terminated, and the remaining three outputs are for the DSCS Frequency Division Multiple Access Control System (DFCS), Radio Frequency Interface System (RFIS), and Single Channel Transponder Injection System (SCTIS) systems. The outputs are next sent to individual eight-way dividers in each rack that route separate RF downlink signals to each downconverter in the rack. The downconverters perform the frequency conversion of the 7.25 to 7.75 GHz RF inputs from the power divider to 70 or 700 MHz IF outputs, which are sent to the DSA. There are a maximum of 32 downconverters in the AN/FSC-78 system. Downconverter rack 1 is always used for antenna tracking. The top downconverters in the remaining racks are used as backups for tracking. The Converter Interface Controller (CIC) controls the automatic switchover of the downconverters in case of failure. The DSA receives up to eight downconverter 70 or 700 MHz IF outputs that are passed via coax transfer switches and route the receive signal to the IF patch panel. The downconverted IF signals are routed from the IF patch panel to the Digital Communications Satellite Subsystem (DCSS).

2.1.4 Transmitter Subsystem

The transmitter assembly consists of the following: four High Power Amplifiers (HPA), comprised of a High Voltage Power Supply (HVPS) and a TWTA; TRIC unit; HPA combiner assembly (HCA); HPA Switching Assembly (HSA); Phasing Monitor Assembly (PMA); transmitter distribution box; Alternating Current (AC) distribution boxes; blower fault panel; and a 28 Volts Direct Current (VDC) power supply. The HVPS provides approximately -15,000 VDC to the cathode of the TWTA. The Control and Display Assembly (CDA) is a computer and screen that is built into the HVPS and provides local and remote switching control of the HPA to aid in troubleshooting.

Commands and status signals from the CDA to the TRIC are distributed internally to the HVPS and TWTA. The output of the four-way combiner is supplied to the TWTA for signal amplification. The TWTA amplifies the 7.9 to 8.4 GHz signal to a maximum of 2.25 kw. The TRIC provides commands to and receives status from the HPA and collocated equipment. The HCA consists of three Variable-Ratio Power Combiners (VRPC). The paired SHF outputs from the HPAs are sent to a separate VRPC in the first stage. The second stage (VRPC 3) combines the outputs of each paired HPA into a balanced composite signal. Each VRPC pair has a phase adjust to obtain the maximum output signal when combining more than one HPA signal. The output is filtered by High Band Stop (HBS) and a Low Band Stop (LBS) filters. The HBS filter attenuates all frequencies above 8.6 GHz and the LBS filter attenuates all frequencies below 7.7 GHz by 40 dB, to remove intermodulation and thermal noise from the transmit signal before being sent to the antenna. The RF signal is sent to the HSA, where it is divided by a four-way power splitter and distributed to the inputs of the four HPAs. The RF signal is applied to all HPAs including off- and on-line HPAs. The HSA accepts test samples from the signal generator routed through the MSTA and controlled by the FMIC. HPA switching is automatically performed by the TRIC if a HPA or path failure occurs. The PMA samples the SHF signals and provides an input to the FMIC. The PMA also selects one of the five RF output samples (four HPA sample outputs and one transmitter assembly sample output) and routes the sample to the MSTA. The PMA provides a means of phasing the HPA signals by manually connecting a sample of the uplink signal to a power meter at the waste port of each VRPC. Transmit power monitoring by a DFCS Network Terminal (NT) is done by the HSA providing a RF sample of the transmitter output. Upconverters perform the 70 or 700 MHz IF frequency conversion to 7.9 to 8.4 GHz SHF or accept an external IF signal and convert it to the transmit frequency. The terminal has the capability of up to 24 upconverters in the system. The upconverter outputs are fed to an eight-way power combiner, and the composite signals are then applied to the transmit signal combiner. The HSA contains two switches: switch S1 is controlled manually and provides the signal for phasing the HPAs and switch S2 is controlled by the FMIC, which routes HPA and uplink samples to the MSTA for testing and monitoring purposes. The composite uplink signal leaves the transmitter assembly and is sent to the antenna.

2.1.5 Tracking Subsystem

The five-horn pseudo-monopulse antenna feed assemblies generate the azimuth and elevation sum and difference signals. These signals are time division multiplexed (TDM) at either a fixed or pseudo-random rate. The signals are used to amplitude modulate the received signal before the input to the receive LNA. The received bandpass combined with the tracking error information is downconverted to a 70 MHz IF signal via a standard downconverter tuned to the DSCS satellite beacon frequency. A sample of this signal is used as the input to the redundant tracking receiver assembly. The receivers demultiplex the azimuth and elevation sum and difference signals then generate the servo error signals. These signals supply the antenna servo electronics the required voltage to generate drive signals. The drive signals are provided to the azimuth and elevation drive motors to move the antenna.

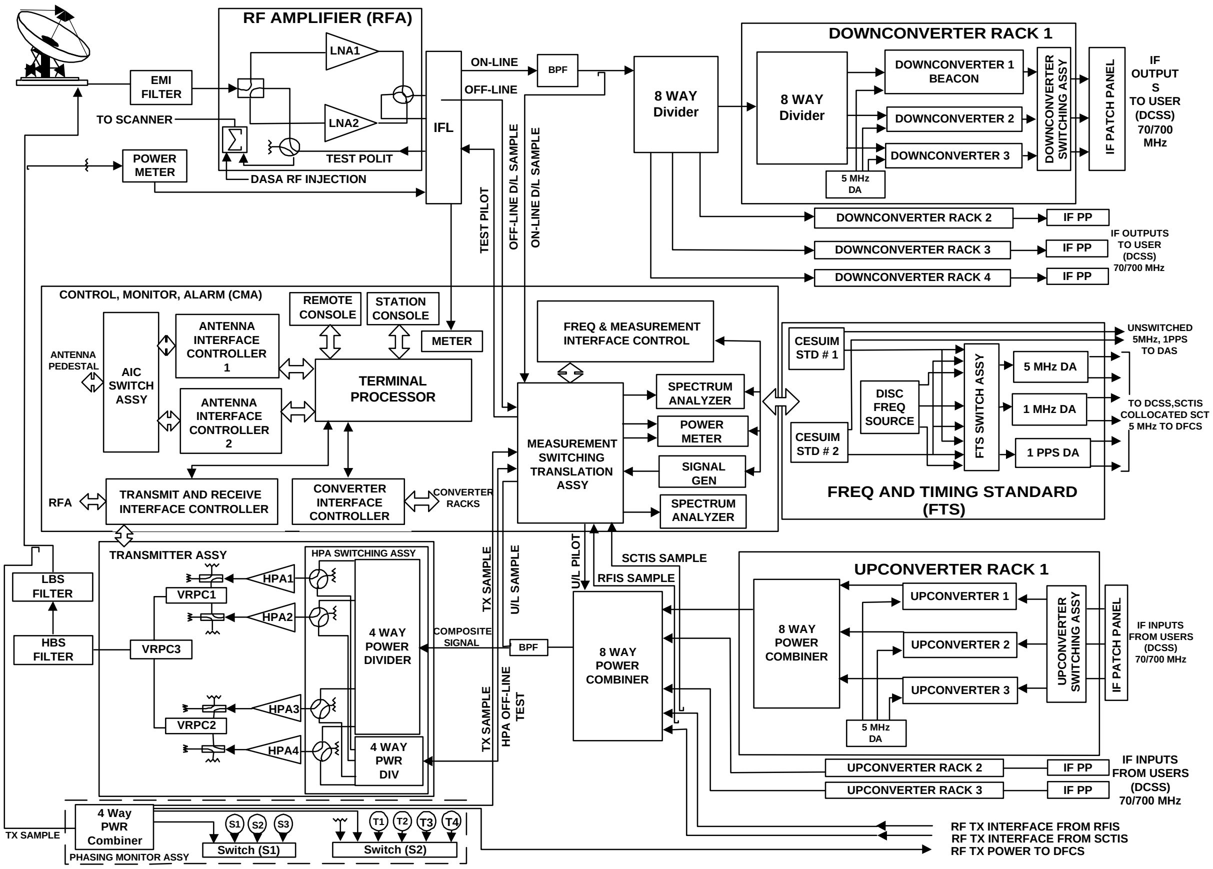

Figure 2-2 AN/FSC-78B Signal Flow Diagram

AN/FSC-78B
SYSTEM CHARACTERISTICS

CHARACTERISTIC/ EQUIPMENT	***VALUE/SPECIFICATION***
Antenna Type/Size	Cassegrain 60-foot
Antenna Feed	5 Horn pseudo-monopulse
Antenna Pedestal Type	Elevation (EL) / Azimuth (AZ) King Post
G/T	38.5 dB
Antenna Gain	Receive 60.54 dB, Transmit 61.27 dB
EIRP	Normal 125 dBm, Combined 127 dBm
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 – 8.4 GHz
Receive Frequency	7.25 – 7.75 GHz
Beacon Carriers	Receive max. of 3, one usable at a time
TX RF Carriers	24 Transmit carriers
RX RF Carriers	32 Receive carriers
Upconverter	40 MHz Bandwidth, O dBm output, 7.9 - 8.4 GHz, Tunable in 1 kHz steps
Downconverter	40 MHz Bandwidth, O dBm output, 7.25 - 7.75 GHz, Tunable in 1 kHz steps
Redundancy	All subsystems except antenna
Fault Location	Automatic
Frequency Control	Synthesizer referenced atomic standard
Carrier Power Level Control	Automatic / Manual
Multiple Access Capability	FDMA, TDMA, SSMA
Power Amplifiers	Redundant 2.25 kw TWTA
Receive Low Noise Amplifiers	Redundant LNA
Prime Power Requirements	133 kVA, 208 / 120V, 50 / 60 Hz
Redundant Power Switchover	Automatic within 200 ms
Antenna Tracking System	Automatic, Manual, Memory
Frequency Standard	5 MHz, 1 MHz, 1 pps outputs, Accuracy $\pm$ 1 part in 10^{-12}, Cesium Beam

Table 2-1 AN/FSC-78B System Characteristics

2.2 AN/FSC-79B, Heavy Terminal

2.2.1 General

The AN/FSC-79B is similar to the AN/FSC-78B. The terminal is no longer supporting the Navy's Fleet Broadcast mission, and the terminals are either being removed or converted to AN/FSC-78B terminal. These terminals will be certified and added to the Department of Defense (DoD) inventory and will provide additional communications capacity on DSCS satellites in the future.

The following description will remain in this handbook until the conversion to AN/FSC-78B is complete and should only be used as reference.

Figure 2-3 AN/FSC-79B

2.2.2 Antenna Subsystem

The antenna is a cassegrain feed horn system configured with a 60-foot main reflector, 7-foot subreflector, and a five-horn monopulse feed system. The antenna main reflector has a parabolic surface. The circular subreflector, which has a contoured surface, is located 18 feet above the feed horn and is supported by a quadripod assembly. The pedestal is constructed as a standard yoke/king post elevation over azimuth design. The equipment room is located behind the antenna feed inside the elevation wheel. The antenna servo and control system uses dual drive motor, antibacklash drive on the azimuth and elevation axis.

2.2.3 Receiver Subsystem

The LNAs provide 70 dB amplification of the composite 7.25 to 7.75 GHz downlink signal. The LNA is adjustable over a 15 dB range by a variable attenuator. The downlink signal is routed to a switch via waveguide and is routed to the appropriate LNA. The TRIC control the on-/off-line LNA status by controlling the dual waveguide/coax switch. Status fault signals are sent to the TRIC. The on-line signal is routed to the signal divider, and the off-line signal is routed to the MSTA. The signal distribution assembly contains a coax switch and summing network. The coax switch routes the test pilot signal either to the off-line LNA or to the summing network to be injected into the downlink system in the antenna feed. The summing network is used to send both the test pilot signal and DASA RF signal into the downlink signal path at the antenna feed or either of the two signals separately. The FMIC controls the distribution assembly coax switch position; it also communicates with the switching assembly for switch positioning, status, and monitoring for testing. There is a power meter located in the EER connected to a directional coupler, via a 20 dB attenuator in the transmit feed. The power meter measures a sample of the transmit RF signal and routes this measurement back to the feed power monitor located in the terminal. The FCG (downlink) contains signal divider assemblies, downconverters, DSA, and a 5 MHz distribution amplifier. The receive signal divider assembly is a power divider which divides the RF downlink signal into eight separate outputs, and it feeds the RF downlink signal to the downconverter racks and other systems. Four of its outputs feed the downconverter racks; one is terminated; and the remaining three outputs are for the DFCS, RFIS, and SCTIS systems. The outputs are next sent to eight-way dividers in each rack that route separate RF downlink signals to each downconverter in the rack. The downconverters perform the frequency conversion of the 7.25 to 7.75 GHz RF inputs from the power divider to 70 or 700 MHz IF outputs, which are sent to the DSAs. There are a maximum of four downconverters in the AN/FSC-79B system. Downconverter rack one is always used for tracking. The top converters in the remaining racks will be used as backups for tracking. The CIC controls the automatic switchover of the converters in case of failure. The DSA receives up to eight downconverter 70 or 700 MHz IF outputs that are passed via coax transfer switches and output the receive signal to the IF patch panel. The downconverted IF signals are routed from the IF patch panel to the DCSS.

2.2.4 Transmitter Subsystem

The transmitter assembly consists of the following: four HPA comprised of HVPS and a TWTA, TRIC, HCA, HSA, PMA; transmitter distribution box; AC distribution boxes; blower fault panel; and a 28 VDC power supply. The HVPS provides approximately –15,000 VDC to the cathode of the TWTA. The CDA is a computer and screen built into the HVPS, and it provides local and remote switching control of the HPA and to aid troubleshooting. Commands and status signals from the CDA to the TRIC are distributed internally to the HVPS and TWTA. The output of the four-way combiner is supplied to the TWTA for signal amplification. The TWTA amplifies the 7.9 to 8.4 GHz signal to a maximum of 2.25 kw. The TRIC is an industrial grade microcomputer configured with appropriate software and hardware to perform the assigned functions. The TRIC provides commands to and receives status from the HPA and collocated equipment. The HCA consist of three VRPCs. The paired SHF outputs from the HPAs are sent to a separate VRPC in the first stage. Second stage combining is done internal to the VRPC; the outputs of each paired HPA are combined into a balanced composite signal. In the third stage, a VRPC combines the outputs of the first two VRPCs when all four HPAs are simultaneously being used. The output is filtered by a HBS and LBS filter. The HBS attenuates all frequencies above 8.6 GHz and the LBS attenuates all frequencies below 7.7 GHz by 40 dB, to remove intermodulation and thermal noise from the transmit signal before being sent to the antenna. The RF signal is sent to the HSA. There it is divided by the four-way power divider and distributed to the inputs of the four HPAs. The RF signal is applied to all off- and on-line HPAs. The HSA accepts test samples from the signal generator routed through the MSTA and controlled by FMIC. HPA switching is automatically performed by the TRIC if a HPA or path failure occurs. The PMA samples the SHF signals and provides an input to the FMIC. The PMA also selects one of the five RF output samples (four HPA sample outputs and one transmitter assembly sample output) and routes the sample to the MSTA. The PMA provides a means of phasing the HPA signals by manually connecting a sample of the uplink signal to a power meter at the waste port of each VRPC. Transmit power monitoring by DFCS is done by the HSA providing a RF sample of the transmitter output. Upconverters perform the 70 or 700 MHz IF conversion to 7.9 to 8.4 GHz SHF or accept an external IF signal and convert it to the transmit frequency. The terminal has the capability of up to three upconverters in the system. All upconverter outputs are fed to an eight-way power combiner, and the composite signals are then applied to the transmit signal combiner. The HSA contains two switches. Switch S1 is controlled manually and provides the signal for phasing the HPAs. Switch S2 is controlled by the FMIC; it routes HPA and uplink samples to the MSTA for testing and monitoring purposes. The composite uplink signal leaves the transmitter assembly and is sent to the antenna.

2.2.5 Tracking Subsystem

The five-horn pseudo-monopulse antenna feed assemblies generate the azimuth and elevation sum and difference signals. These signals are TDM at either a fixed or pseudo-random rate. The signals are used to amplitude modulate the received signal before the input to the LNAs. The received bandpass combined with the tracking error information is downconverted to a 70 MHz IF signal via a standard downconverter tuned to the DSCS satellite beacon frequency. A sample of this signal is used as the input to the redundant tracking receiver assembly. The receivers demultiplex the azimuth and elevation sum and difference signals then generate the servo error signals. These signals supply the antenna servo electronics the required voltage to generate drive signals. The drive signals are provided to the azimuth and elevation drive to move the antenna.

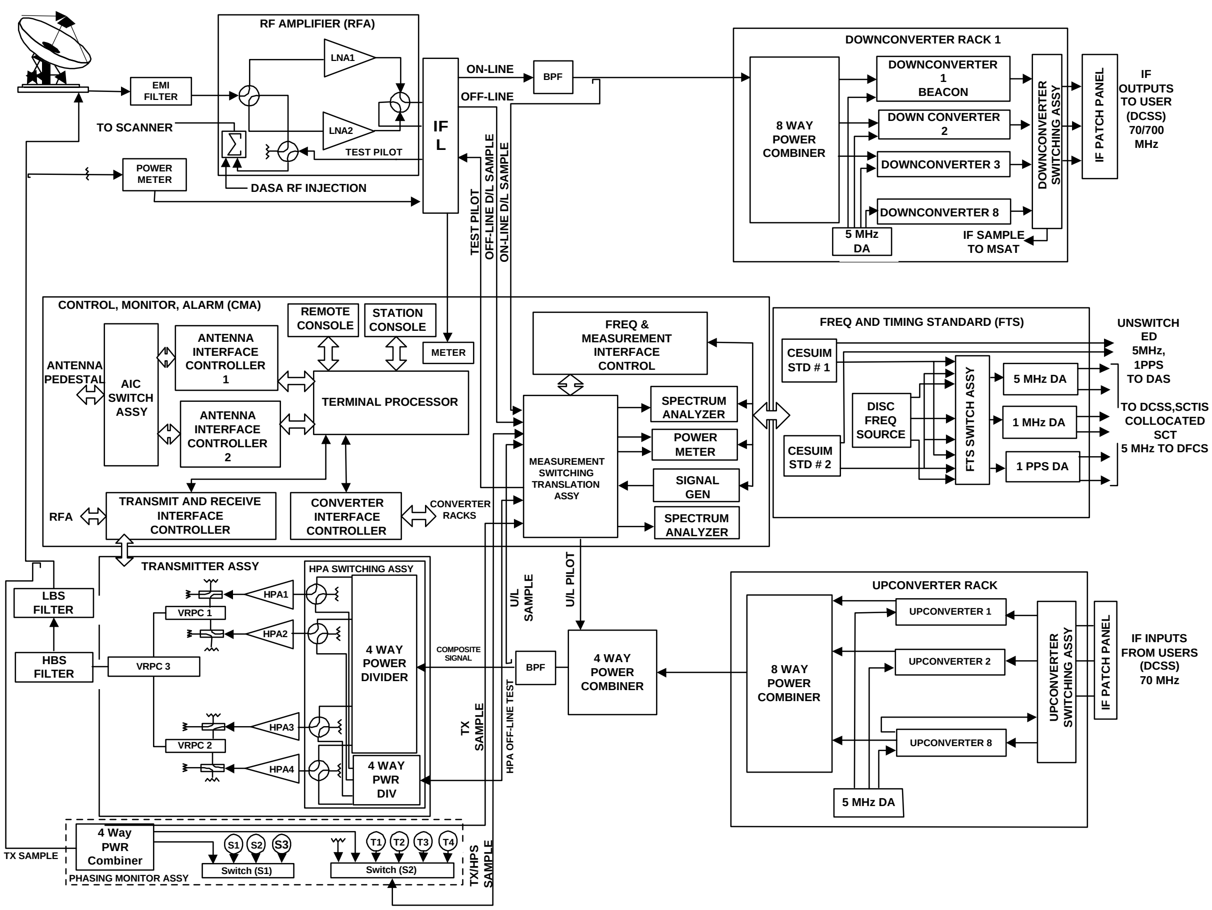

Figure 2-4 AN/FSC-79B Signal Flow Diagram

AN/FSC-79B
SYSTEM CHARACTERISTICS

CHARACTERISTIC/ EQUIPMENT	*VALUE/SPECIFICATION*
Antenna Type/Size	Cassegrain 60-foot
Antenna Feed	5 Horn pseudo-monopulse
Antenna Pedestal Type	Elevation (EL) / Azimuth (AZ) King Post
G/T	38.5 dB
Antenna Gain	Receive 60.54 dB, Transmit 61.27 dB
EIRP	Normal 125 dBm, Combined 127 dBm
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 – 8.4 GHz
Receive Frequency	7.25 – 7.75 GHz
Beacon Carriers	Receive max. 3, one usable at a time
TX RF Carriers	3 Transmit carriers
RX RF Carriers	4 Receive carriers
Upconverter	8 Upconverters, 40 MHz Bandwidth, O dBm output, 7.9 – 8.4 GHz, Tunable in 1 kHz steps
Downconverter	8 Downconverters, 40 MHz Bandwidth, O dBm output, 7.25 - 7.75 GHz, Tunable in 1 kHz steps
Redundancy	All subsystems except antenna
Fault Location	Automatic
Frequency Control	Synthesizer referenced atomic standard
Carrier Power Level Control	Automatic / Manual
Multiple Access Capability	FDMA, TDMA, SSMA
Power Amplifiers	Redundant 2.25 kw TWTA
Receive Low Noise Amplifiers	Redundant LNA
Prime Power Requirements	133 kVA 208 / 120V 50 / 60 Hz
Redundant Power Switchover	Automatic within 200 ms
Antenna Tracking System	Automatic, Manual, Memory
Frequency Standard	5 MHz, 1 MHz, 1 pps outputs, Accuracy $\pm$ 1 part in 10^{-12}, Cesium Beam.

Table 2-2 AN/FSC-79B System Characteristics

2.3 AN/GSC-39(V), Medium Terminal

2.3.1 General

The AN/GSC-39(V)1 is the standard DSCS medium terminal (MT) for fixed sites, and the AN/GSC-39(V)2 is designed for mobile requirements. With the exception of the interface hardware, all major components are interchangeable between the (V)1 and (V)2 versions. Designed to operate within the SHF spectrum, the AN/GSC-39(V) is a multiple carrier, 500 MHz instantaneous bandwidth terminal.

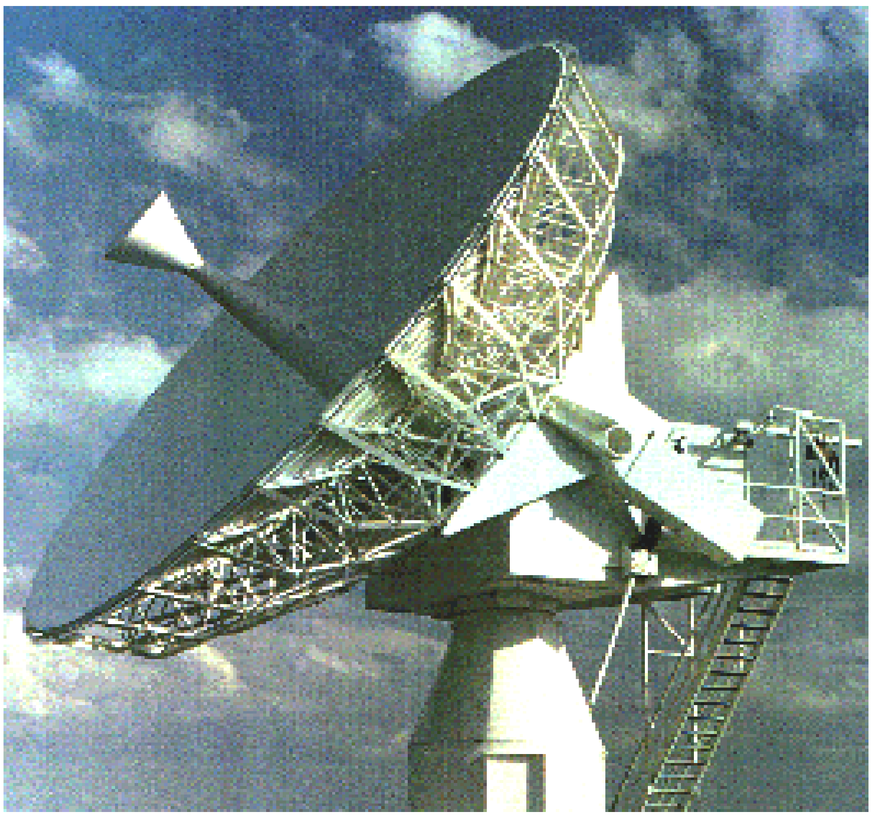

Figure 2-5 AN/GSC-39(V)

The heart of the communications equipment features wideband access at 70 and 700 MHz IF to accommodate both analog and digital interfaces. The antenna subsystem consists of a 38-foot, high-efficiency reflector, and a pedestal housing the antenna drive mechanisms. The antenna has a cassegrain feed system with a four horn pseudo-monopulse antenna that can be dismantled and stored in reusable containers for rapid deployment. Receive LNAs are installed in a redundant configuration and mounted at the base of the feed horn on the rear of the antenna. The LNA subsystem provides a signal gain of 70 dB and feeds up to 32 downconverters. The transmit side has nine upconverters and four TWTAs with an output of 2.25 kw each. A switch combining network permits the power amplifiers to operate in a redundant or parallel configuration. The parallel configuration combines the power output of the transmitters at 9 kW minus the equipment insertion loss. The equipment in the (V)1 is installed in a fixed configuration in a building. The equipment in the (V)2 configuration is located in vans which are transportable by C5-A or similar aircraft. The transmitter van houses four 2.25 kw power amplifiers. The operations van contains the frequency conversion distribution subsystem and the operator's console. The maintenance van houses the test and repair facilities. The supply van provides a storage area for critical repair parts, which may be required during remote operations.

2.3.2 Antenna Subsystem

The antenna has a cassegrain feed horn system configured with a 38-foot, high efficiency reflector and a five-horn monopulse feed system. The antenna main reflector has a parabolic surface, and the feed assembly consists of a subreflector, communications and tracking error horns, and filters housed in a single dielguide assembly. The circular subreflector is located 8 feet above the feed horn and is supported by a dielguide assembly. Antenna positioning is achieved by the use of dual opposing azimuth and elevation motors.

2.3.3 Receiver Subsystem

The LNAs provide 70 dB amplification of the composite 7.25 to 7.75 GHz downlink signal. The LNA is adjustable over a 15 dB range by a 15 dB variable attenuator. The downlink signal is routed to the switch via waveguide and is routed to the appropriate LNA. The TRIC controls the on-/off-line LNA status by controlling the dual waveguide/coax switch. Status fault signals are sent to the TRIC. The on-line signal is routed to the signal divider and the off-line signal is routed to the MSTA. The signal distribution assembly contains a coax switch and summing network. The coax switch routes the test pilot signal either to the off-line LNA or to the summing network to be injected into the downlink system in the antenna feed. The summing network is used to send both the test pilot signal and DASA RF signal into the downlink signal at the antenna feed or either of the two signals separately. The FMIC provides control of the distribution assembly coax switch position, and it also communicates with the switching assembly for switch positioning, status, and monitoring for testing. There is a power meter located in the EER connected to a directional coupler, via a 20 dB attenuator in the transmit feed. The power meter measures a sample of the transmit RF signal and routes this measurement back to the feed power monitor located in the terminal. The FCG (downlink) contains signal divider assemblies, downconverters, DSA, and a 5 MHz distribution amplifier. The receive signal divider assembly is a power divider which divides the RF downlink signal into eight separate outputs. Four of its outputs are fed to the downconverter racks, one is terminated and the remaining outputs are for the RFIS and SCTIS systems. The outputs are next sent to eight-way way dividers in each downconverter rack and then sent to each downconverter in the rack. The downconverters perform the frequency conversion of the 7.25 to 7.75 GHz RF inputs from the power divider to 70 or 700 MHz IF outputs, which are sent to the DSAs. There are a maximum of 32 downconverters in the AN/GSC-39(V) system. Downconverter rack 1 is always used for tracking. The top converters in the remaining racks will be used as backups for tracking. The CIC controls the automatic switchover of the converters in case of failure. The DSA receives up to eight downconverter 70 or 700 MHz IF outputs that are passed via coax transfer switches and routes the receive signal to the IF patch panel. The downconverted IF signals are routed from the IF patch panel to the DCSS.

2.3.4 Transmitter Subsystem

The transmitter assembly consists of the following: four HPAs comprised of HVPS and a TWTA, TRIC, HCA, HAS, PMA; transmitter distribution box; AC distribution boxes; blower fault panel; and a 28 VDC power supply. The HVPS provides approximately –15,000 VDC to the cathode of the TWTA. The CDA is a computer and screen built into the HVPS and provides local and remote switching control of the HPA to aid in troubleshooting. Commands and status signals from the CDA to the TRIC are distributed internally to the HVPS and TWTA. The output of the four-way combiner is supplied to the TWTA for signal amplification. The TWTA amplifies the 7.9 to 8.4 GHz signal to a maximum of 2.25 kW. The TRIC is an industrial grade microcomputer configured with appropriate software and hardware to perform the assigned functions. The TRIC provides commands to and receives status from the HPA and collocated equipment. The HCA consist of three VRPCs. The paired SHF outputs from the HPAs are sent to a separate VRPC in the first stage. The second stage combining is done internal to the VRPC; the outputs of each paired HPA are combined into a balanced composite signal. In the third stage, a VRPC combines the outputs of the first two VRPCs when all four HPAs are simultaneously being used. The output is filtered by HBS filter and LBS filters. The HBS filter attenuates all frequencies above 8.6 GHz, and the LBS filter attenuates all frequencies below 7.7 GHz by 40 dB, to remove intermodulation and thermal noise from the transmit signal before being send to the antenna. The RF signal is sent to the HSA, where it is divided by the four-way power divider. The output of the HSA is divided and distributed to the inputs of the four HPAs. The RF signal is applied to all HPAs including the off-line HPAs. The HSA accepts test samples from the signal generator routed through the MSTA and controlled by the FMIC. HPA switching is automatically performed by the TRIC if a HPA or path failure occurs. The PMA samples the SHF signals and provides an input to the FMIC. The PMA also selects one of the five RF output samples (four HPA sample outputs and one transmitter assembly sample output) and routes the sample to the MSTA. The PMA provides a means of phasing the HPAs by manually connecting a sample of the uplink signal to a power meter at the waste port of each VRPC. Upconverters perform the 70 or 700 MHz IF conversion to 7.9 to 8.4 GHz or accept an external IF signal and convert it to the transmit frequency. The terminal has the capability of up to 24 upconverters in the system. The upconverter outputs are fed to eight-way power combiners, and the composite signals are then applied to the transmit signal combiner. The HSA contains two switches. Switch S1 is controlled manually and provides the signal for phasing the HPAs. Switch S2 is controlled by the FMIC; it routes HPA and uplink samples to the MSTA for testing and monitoring purposes. The composite uplink signal leaves the transmitter assembly and is sent to the antenna.

2.3.5 Tracking Subsystem

The five-horn pseudo-monopulse antenna feed outputs generate the azimuth and elevation sum and difference signals. These signals are multiplexed using TDM at either a fixed or pseudo-random rate. The signals are used to amplitude modulate the received signal before the input to the parametric amplifier. The received bandpass combined with the tracking error information is downconverted to a 70 MHz IF signal via a standard downconverter tuned to the DSCS satellite beacon frequency. A sample of this signal is used as the input to the redundant tracking receiver. The receivers demultiplex the azimuth and elevation sum and difference signals then generate the servo error signals. These signals supply the antenna servo electronics the required voltage to generate drive signals. The drive signals are provided to the azimuth and elevation drive motors to move the antenna.

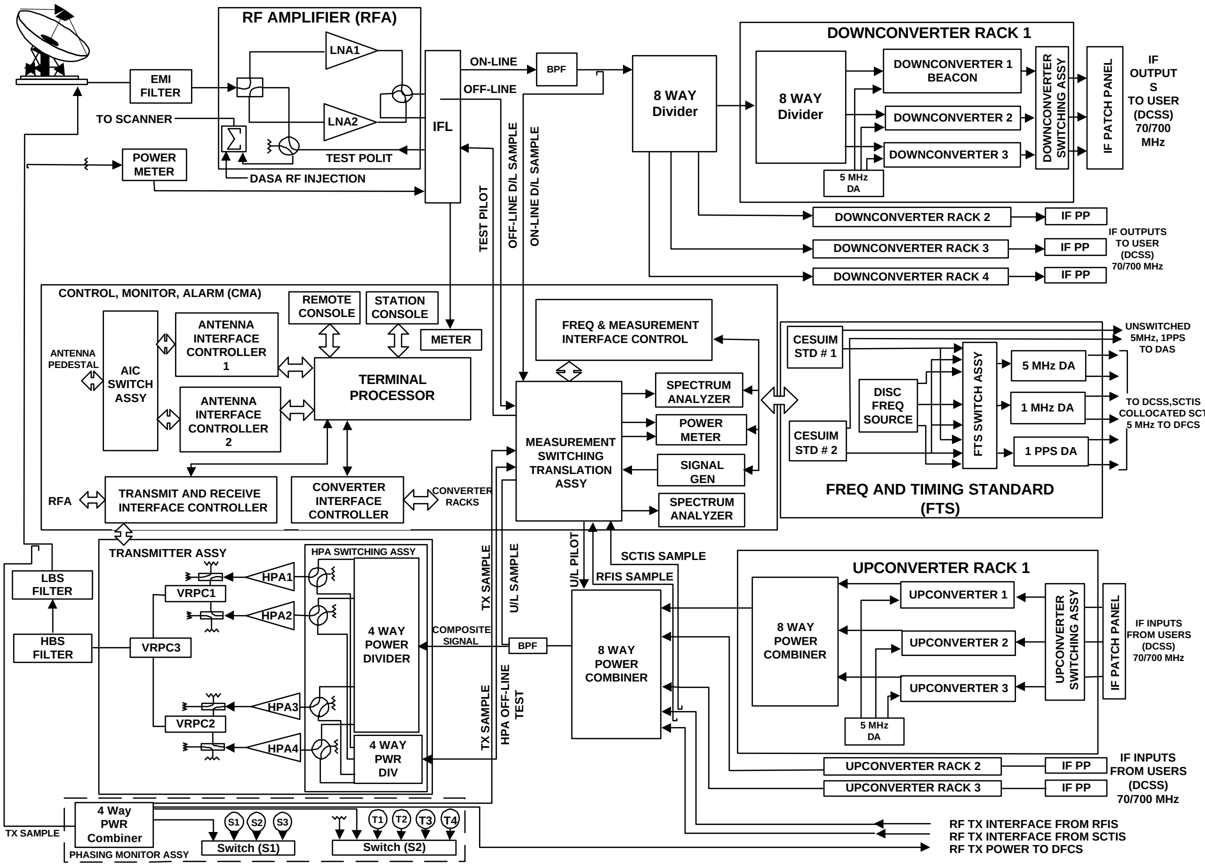

Figure 2-6 AN/GSC-39(V) Signal Flow Diagram

AN/GSC-39(V)
SYSTEM CHARACTERISTICS

CHARACTERISTIC/ EQUIPMENT	*VALUE/SPECIFICATION*
Antenna Type/Size	Cassegrain 38-foot
Antenna Feed	4 Horn Pseudo-monopulse
Antenna Pedestal Type	Dual azimuth / elevation
G/T	33 dBm
Antenna Gain	56.58 dB Receive, 57.3 dB Transmit
EIRP	117 dBm
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 – 8.4 GHz
Receive Frequency	7.25 – 7.75 GHz
Beacon Carriers	Receive max. of 3, one usable at a time
TX RF Carriers	24 Transmit carriers
RX RF Carriers	32 Receive carriers
Upconverter	40 MHz Bandwidth, O dBm output, 7.9 - 8.4 GHz,

	Tunable in 1kHz Steps
Downconverter	40 MHz Bandwidth, O dBm output, 7.25 - 7.75 GHz, Tunable in 1kHz Steps
Redundancy	All subsystems except antenna
Fault Location	Automatic
Frequency Control	Synthesizer referenced atomic standard
Carrier Power Level Control	Automatic / Manual
Multiple Access Capability	FDMA, TDMA, SSMA
Power Amplifiers	Redundant 2.25 kw TWTA
Receive Low Noise Amplifiers	70 dB Gain, Redundant LNA
Prime Power Requirements	133 kVA, 208/120V, 50/60 Hz
Redundant Power Switchover	Automatic within 200 ms
Antenna Tracking System	Automatic, Manual, Memory
Frequency Standard	5 MHz, 1 MHz, 1 pps outputs, Accuracy $\pm$ 1 part 10^{-12}, Cesium Beam

Table 2-3 AN/FSC-39(V) System Characteristics

2.4 AN/GSC-52(V), Medium Terminal

2.4.1 General

The AN/GSC-52(V) is a fixed or mobile medium size SHF satellite ground terminal (SGT) designed for use with the DSCS. It is a high-capacity, high altitude electromagnetic pulse (HEMP) protected terminal that uses pseudo-monopulse scanning for operator-selectable manual tracking, memory tracking, or acquisition/auto tracking of the satellite. The terminal consists of an antenna subsystem, a receive subsystem, a transmit subsystem, and tracking/servo subsystem. The antenna subsystem has a cassegrain feed, 38-foot parabolic reflector antenna, an elevation over azimuth pedestal, and a servo-drive mechanism. On the transmit side, 70 MHz or 700 MHz IF and outputs transmit frequency 7.9 to 8.4 GHz. The output of the upconverters are combined into a composite RF signal with a bandwidth of 500 MHz. The TWTA amplifies the composite signal and routes it via waveguide to the antenna subsystem. On the receive side, the antenna receives the RF signal at 7.25 to 7.75 GHz, amplifies the signal using LNAs and the interfacility amplifiers, and passes the signal to downconverters with a 70 or 700 MHz IF output. The AN/GSC-52(V) uses 12 upconverters and 12 downconverters (may be expanded to 18 and 24 respectively) for conversion of signals to and from the IF. The terminal is capable of manned or unmanned operations through a centralized control, monitor, and alarm subsystem that provides computer-aided configuration for control, status and performance monitoring, equipment calibration, fault isolation, and automatic switching of redundant equipment.

Figure 2-7 AN/GSC-52(V)

2.4.2 Antenna Subsystem

The antenna is a cassegrain feed horn system configured with a 38-foot high efficiency reflector and a five-horn monopulse feed system. The antenna main reflector has a parabolic surface and the feed assembly consists of a subreflector, communications and tracking horns, and filters housed in a single dielguide assembly. The pedestal is constructed as a standard yoke/king post elevation over azimuth design. The equipment room is located behind the antenna feed inside the elevation wheel. The antenna servo and control system uses dual drive motor, antibacklash drive on the azimuth and elevation axes.

2.4.3 Receive Subsystem

The receive band frequency range is 7.25 to 7.75 GHz. The receive subsystem receives the composite downlink signal form the satellite via the antenna reflector and feed assembly. The signal is filtered and fed to the on-line LNA/Interfacility Link Amplifier (IFLA). The LNA/IFLA amplifies the signal to a suitable power level and routes it to the downlink RF sample assembly where it is divided into the appropriate composite signal for each downconverter rack. The composite downlink signal is also routed, via the user input/output interface, to the DCSS for monitoring of the complete receive spectrum. In each downconverter rack, the composite signal is further divided to feed individual downconverters. Each of the 18 downconverters are tuned to a channel in the receive band of 7.25 to 7.75 GHz and each one translates the SHF input into a 70/700 MHz output signal. The output signals are patched to the user input/output interface via the receive IF patch panel. The signal is then routed from the terminal to the DCSS as the user 70/700 MHz receive IF signal.

2.4.4 Transmitter Subsystem

The 70/700 MHz transmit signals from the DCSS are connected to the terminal through the users input/output interface and patched to the upconverter racks via the transmit IF patch panel. Each of the upconverters are tuned to SHF frequencies in the transmit band of 7.9 to 8.4 GHz. The individual upconverters translate the IF input to the assigned channel frequency at the required output power level. Within the upconverter racks, the outputs of the converters are combined to form a composite signal, which also contains RF user input if present. The uplink pilot signal generated by the signal generator is combined with the composite signal via the upconverter rack. The composite outputs of the upconverter racks are combined in the uplink RF sample assembly to form the composite uplink signal, at a maximum level of –13 dBm. The combined uplink signal is routed via the interfacility link (IFL) to the transmit assembly. In the transmit assembly the uplink signal is divided and amplified by two identical intermediate power amplifiers (IPA), to provide redundancy in the event of failure. The outputs of the IPAs are recombined and then further divided to provide equal drive power to the four HPAs. Two of the HPAs are used in the normal mode and all four in the stressed mode. The HPA outputs are combined to form the composite uplink signal. The paired SHF outputs form the HPAs are sent to a separate VRPC in the first stage. The second stage combining is done internal to the VRPC; the outputs of each paired HPA are combined into a balanced composite signal. In the third stage, a VRPC combines the outputs of the first two VRPCs when all four HPAs are simultaneously being used. This signal is filtered and radiated to the satellite via the feed assembly and antenna reflector.

2.4.5 Tracking Subsystem

Four quadrature error horns are located in the feed assembly, which receive equal signal strength when the antenna is pointing directly at the satellite and unequal signal strength when a tracking error is present. The output from each horn is sent into a comparator, which provides filtered azimuth (AZ) and elevation (EL) error signals to the scanner assembly. In the autotrack mode, the output of the scanner assembly (tracking error) is amplitude modulated onto the composite downlink signal, and the autotrack unit receives a sample of this signal from the on-line LNA/IFLA output via the variable bandpass filter. The sample is synchronously demodulated using the original sampling control signals to produce the AZ and/or EL velocity commands when a tracking error is detected. The commands are applied to the antenna control unit, which corrects the error via the antenna servo drive system. The memory-tracking unit maintains a 24-hour record of the antenna tracking movement. This record can be used to control the antenna in the memory track mode if an auto track failure occurs.

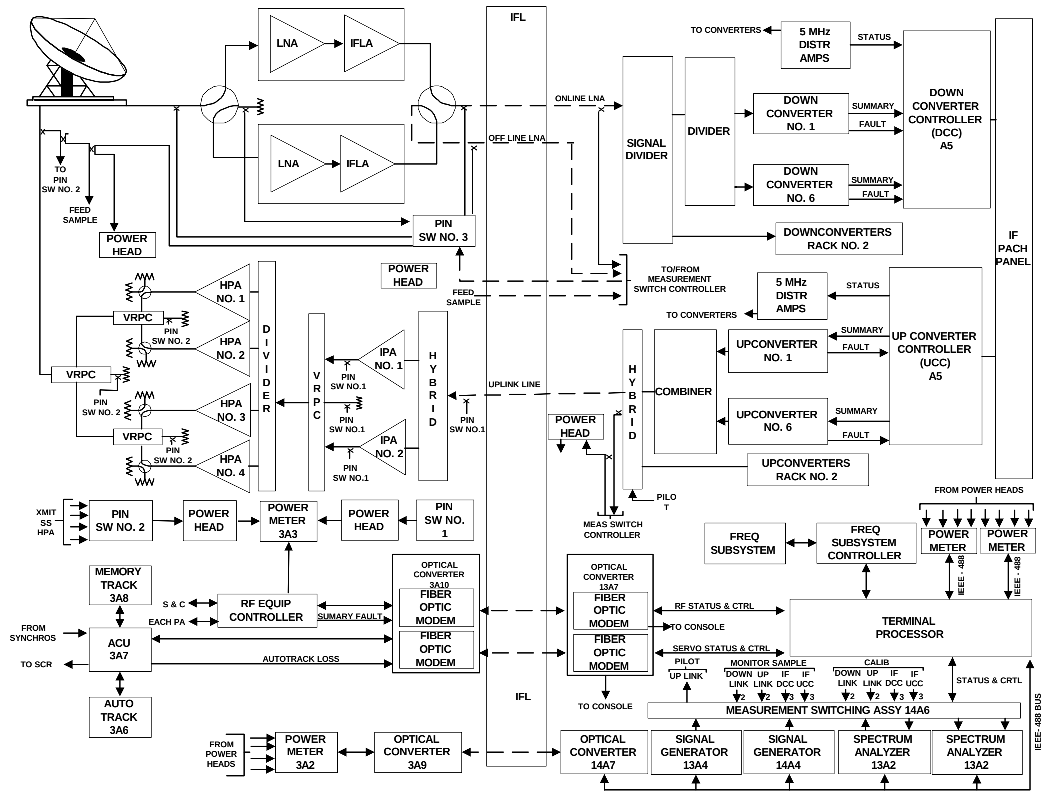

Figure 2-8 AN/GSC-52(V) Signal Flow Diagram

AN/GSC-52(V)
SYSTEM CHARACTERISTICS

CHARACTERISTIC/ EQUIPMENT	*VALUE/SPECIFICATION*
Antenna Type/Size	Cassegrain 38-foot,
Antenna Feed	5 Horn pseudo-monopulse
Antenna Pedestal Type	Dual opposing azimuth and elevation motors
G/T	34 dBm
Antenna Gain	56.58 dB Receive, 57.3 dB Transmit
EIRP	119 dBm
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 – 8.4 GHz
Receive Frequency	7.25 – 7.75 GHz
Beacon Carriers	Receive 3 max one usable at a time
TX RF Carriers	12 expandable to 18
RX RF Carriers	12 expandable to 18
Upconverter	40 MHz Bandwidth, O dBm output, 7.9 - 8.4 GHz, Tunable in 1 kHz steps
Downconverter	40 MHz Bandwidth, O dBm output, 7.25 – 7.75 GHz, Tunable in 1 kHz steps

Redundancy	All Subsystem except antenna
Fault Location	Automatic
Frequency Control	Synthesizer referenced atomic standard
Carrier Power Level Control	Automatic / Manual
Multiple Access Capability	FDMA, TDMA, SSMA
Power Amplifiers	Redundant 5 kW TWTA
Receive Low Noise Amplifiers	LNA
Prime Power Requirements	117 kVA, 208/120 V, 50/60 Hz
Redundant Power Switchover	Automatic within 200 ms
Antenna Tracking System	Automatic, Manual, Memory
Frequency Standard	5 MHz, 1 MHz, 1 pps outputs, Accuracy $\pm$ 1 part in 10^{-12}.

Table 2-4 AN/GSC-52(V) System Characteristics

2.5 AN/SCT-20, Light Terminal

2.5.1 General

The AN/SCT-20 is a terminal supporting Special Departmental User (DEPUS) missions. The terminal is a modified AN/GSC-49 terminal with the same RF equipment suite. The AN/USC-28 Spread Spectrum Modem has been removed and replaced with a special user baseband equipment suite.

AN/SCT-20
SYSTEM CHARACTERISTICS

CHARACTERISTIC/ EQUIPMENT	***VALUE/SPECIFICATION***
Antenna Type/Size	AS-3199/TSC, 20-foot
Antenna Feed	Cassegrain
Antenna Pedestal Type	Dielectric monopod
G/T	27 dB
Antenna Gain	Receive 49.8 dB, Transmit 50.66 dB
EIRP	107 dBm
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 - 8.4 GHz
Receive Frequency	7.25 - 7.75 GHz
Beacon Carriers	1 Beacon Tracking Receiver
TX RF Carriers	1 Transmit carrier
RX RF Carriers	1 Receive carrier
Upconverter	2 Downconverters, 40 MHz instantaneous bandwidth
Downconverter	2 Upconverters, 40 MHz instantaneous bandwidth
Redundancy	Upconverters, Downconverters, LNAs, HPAs
Fault Location	Manual
Frequency Control	1 kHz Steps, Synthesizer referenced to Cesium Beam Frequency Standard
Carrier Power Level Control	Automatic
Multiple Access Capability	FDMA
Power Amplifiers	Redundant 1 kw, Air cooled klystrons
Receive Low Noise Amplifiers	Redundant LNA, AM-7135/GSC
Prime Power Requirements	Two PU-650 B/G 60 kW generators or commercial power 108-132/187-229 Volts, 3 phase, 4 wire 47-63 Hz
Redundant Power Switchover	Manual
Antenna Tracking System	Automatic (step tracking), Manual
Frequency Standard	5 MHz, 1 MHz, 1 pps outputs, Accuracy $\pm$ 1 part in 10^{-12}, Cesium Beam

Table 2-5 AN/SCT-20 System Characteristics

2.6 AN/TSC-86, Light Terminal

2.6.1 General

The AN/TSC-86 is the standard Light Terminal (LT) used in the DSCS network. The terminal is a lightweight transportable Strategic Terminal designed for rapid deployment. It is primarily used in support of JCS contingency operations. The terminal is housed in a modified S-280 shelter mounted on a 2 ½-ton M35 truck. The 8-foot antenna is ground assembled during operations. Power is supplied to the terminal by two engine generators that have been palletized to form the power generation system. The power generation system is equipped with a selectable switch to enable the selection of commercial power or use of the two generators.

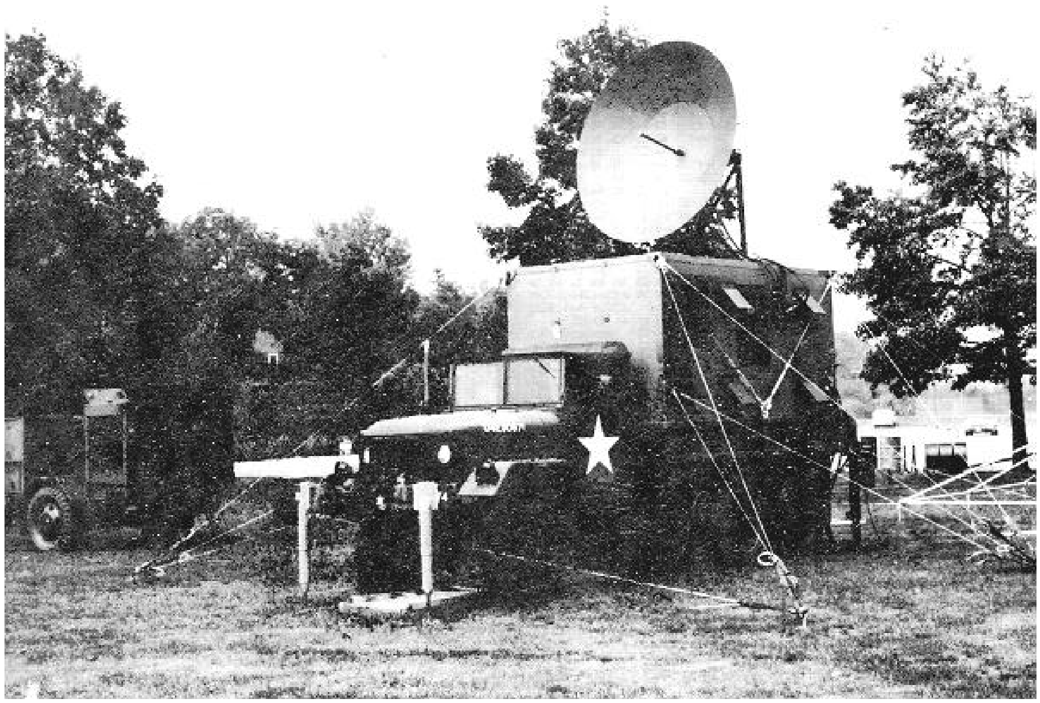

Figure 2-9 AN/TSC-86

2.6.2 Antenna Subsystem

The terminal can be operated with either the AS-3036/TSC 8-foot antenna or the AS-3199/TSC 20-foot antenna. The 8-foot antenna is sectionalized which allows it to be stored in the shelter. It has a splash plate feed that provides a receive gain of 42.5 dB and a transmit signal gain of 43.5 dB. The antenna uses a splash plate feed assembly, which provides a minimum efficiency of 55 percent. The beam width is approximately 1.3 degrees for the AS-3036/TSC 8-foot antenna. Sidelobe levels are at least 15 dB below the main beam. The antenna uses limited coverage tracking actuators. These actuators are controlled by a step tracking subsystem, which uses the strength of the beacon or communications carrier as the control signal. The 20-foot antenna (AS-3199/TSC) enhances the terminal performance and is transported in the 31-foot DSCS van. The reflector is sectionalized consisting of 32 panels, which attach to the central hub and backing structure. The sub-reflector is supported by a dielectric monopod to eliminate intermodulation products associated with support spars. The transmit and receive gain of the antenna is 55 dB minimum. The AS-3199/TSC antenna has a receive beamwidth of 0.42 degrees and a transmit beamwidth of 0.37 degrees. The antenna uses limited coverage tracking actuators. These actuators are controlled by a step tracking subsystem, which uses the strength of the beacon or communications carriers as the control signal.

2.6.3 RF/IF Subsystem

The RF/IF subsystem is equipped with redundant equipment and manual switchover capability. The terminal is equipped with four upconverters and four downconverters, which are used in support of the four duplex links. When the 8-foot antenna (AS-3036/TSC) is in use by the terminal, only one uplink can be supported due to EIRP limitation.

2.6.4 Receiver Subsystem

Signals received by the antenna are routed through waveguide to redundant low noise ambient cooled LNAs. The LNAs are mounted at the antenna feed at the rear of the reflector assembly. The combination of the antenna and the LNA provides a G/T 18/K (8-foot antenna) or 26 dB/K (20-foot antenna). The LNAs provide the amplification of the receive signals which are routed through low loss coaxial cable to the receive signal divider. The signal divider provides outputs for a maximum of four downconverters and redundant beacon receivers. The downconverters have dual conversion capability which are used to translate the RF to 700 MHz IF and then to 70 MHz IF.

2.6.5 Transmitter Subsystem

The RF outputs of the upconverters are filtered, combined, and amplified by the solid state IPA to levels suitable for driving the final power amplifier. The upconverters translate the IF signals to the RF spectrum of 7.9 GHz to 8.4 GHz transmit frequency range. The power amplifier uses a five cavity Klystron, with a bandwidth of 40 MHz tunable over a 500 MHz transmit band. The output of the transmitter is routed through a waveguide patch panel, which provides the capability of manual selection of the power amplifier on-line or dummy load.

2.6.6 Tracking Subsystem

The antenna tracking system is equipped with redundant beacon receivers and uses a step tracking method for satellite tracking.

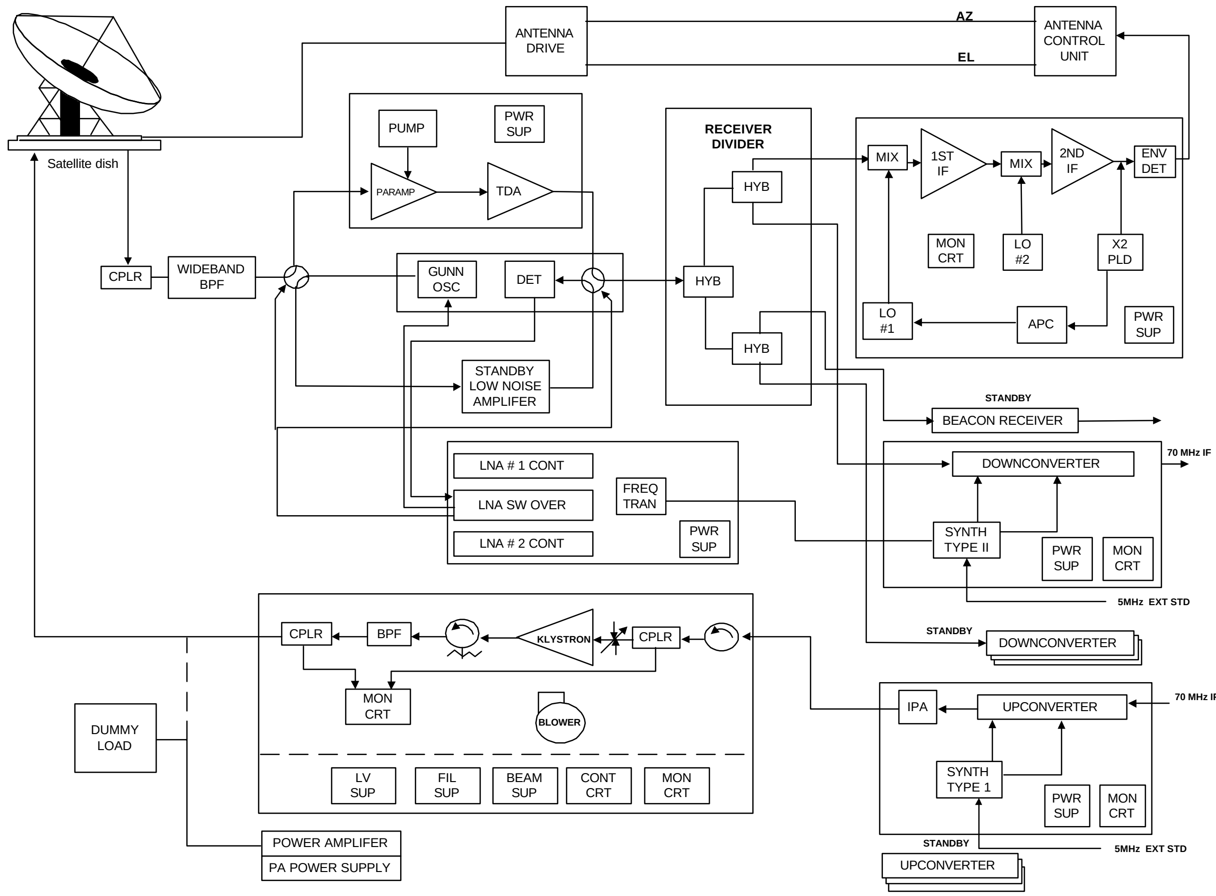

Figure 2-10 AN/TSC-86 Signal Flow Diagram

AN/TSC-86
SYSTEM CHARATERISTICS

CHARACTERISTIC/ EQUIPMENT	***VALUE/SPECIFICATION***
Antenna Type/Size	AS-3036/TSC, 8-foot AS-3199/TSC, 20-foot
Antenna Feed	AS-3036/TSC, Splash plate, AS-3199/TSC, Cassegrain
Antenna Pedestal Type	Tripod (both antennas)
G/T	AS-3036/TSC, 18 dB, AAS-3199/TSC, 26 dB
Antenna Gain	AS/3036/TSC, 43.5 dB TX, 42.5 dB RX AS-3199/TSC, 52.78 dB TX, 52.05 dB RX
EIRP	111.0 dB AS-3199/TSC, 103 dB AS-3036/TSC
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 - 8.4 GHz
Receive Frequency	7.25 - 7.75 GHz
Beacon Carriers	One beacon downconverter/receiver
TX RF Carriers	4 Transmit carriers
RX RF Carriers	4 Receive carriers
Upconverter	4 Upconverters
Downconverter	4 Downconverters
Redundancy	Up/Downconverters, HPAs, LNAs
Fault Location	Manual
Frequency Control	1 kHz Steps
Carrier Power Level Control	0 – 30 dB in 1 dB steps
Multiple Access Capability	FDMA
Power Amplifiers	HPA, Klystron, 1 kw
Receive Low Noise Amplifiers	Redundant, Auto switching
Prime Power Requirements	110/208 VAC, 50-60 Hz, 3 Wire
Redundant Power Switchover	Manual
Antenna Tracking System	Manual, Automatic (Step Tracking)
Frequency Standard	5 MHz

Table 2-6 AN/TSC-86 System Characteristics

2.7 AN/TSC-86A, Joint Chiefs of Staff (JCS) Contingency Terminal (JCT)

2.7.1 General

The AN/TSC-86A, JCT will be used strictly by the JCS to perform contingency missions. This terminal is in the developmental stages and will replace the last AN/TSC-86 in the DoD inventory. Upgrades to this terminal will include HT-modified and Medium Terminal (MT)-modified equipment. The system will be equipped with AN/FCC-100, ADNX-48, and Integrated Digital Network (IDNX) multiplex equipment; OM-73 modems; HT-modified upconverters and downconverters; and HT-modified HPAs. The system will be equipped with the AS-3199/TSC, OE-316(V) 20-foot antenna systems, or the AS-3036/TSC 8 foot antenna. All components in these antenna systems will remain the same.

This section will be updated following full-scale development of this terminal. Figure 2-11 illustrates the proposed signal flow diagram for the system.

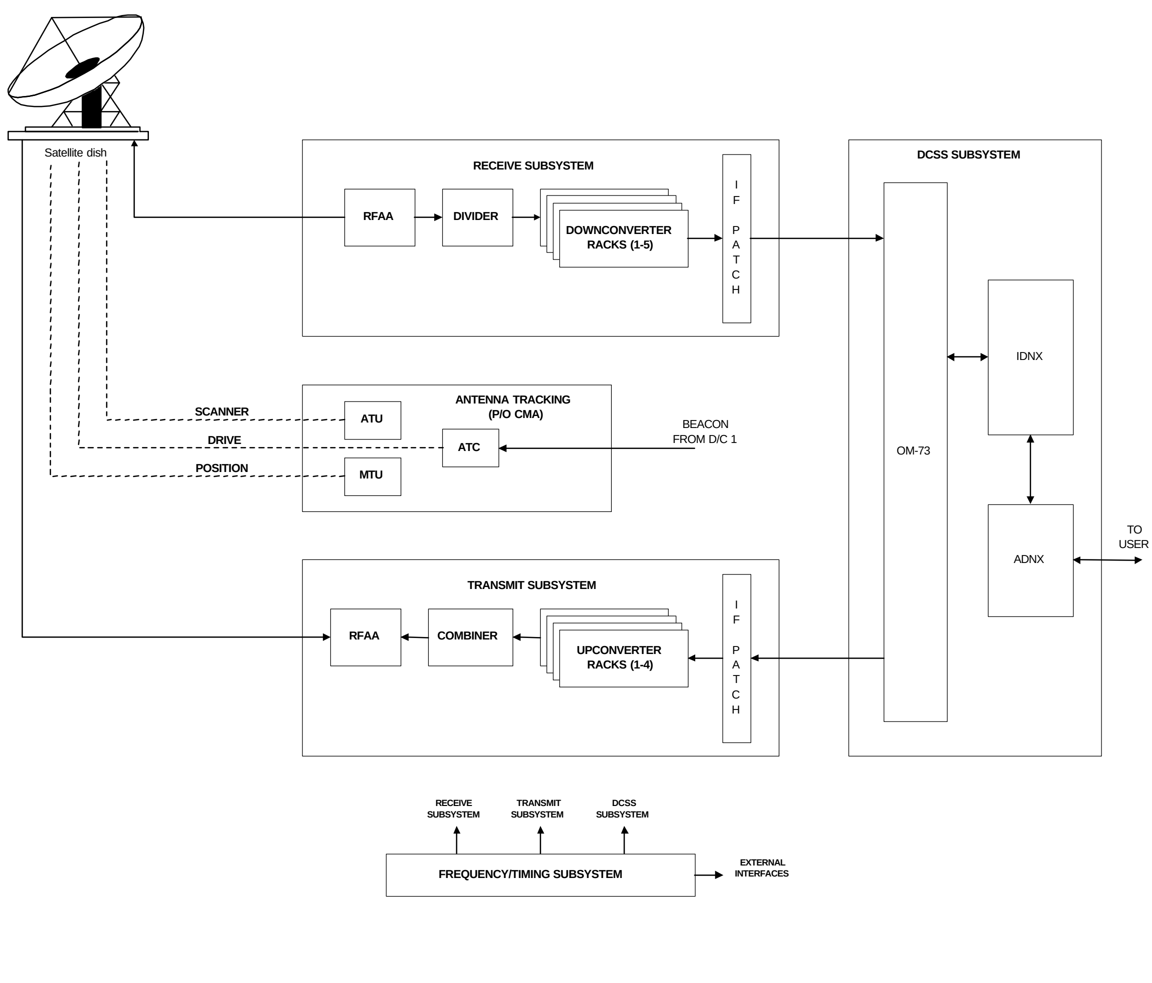

Figure 2-11 AN/TSC-86A Signal Flow Diagram

AN/TSC-86A
SYSTEM CHARATERISTICS

CHARACTERISTIC/ EQUIPMENT	*VALUE/SPECIFICATION*
Antenna Type/Size	AS-3036/TSC, 8-foot AS-3199/TSC, 20-foot OE-316 (QRSA), 20 foot
Antenna Feed	AS-3036/TSC, Splash plate AS-3199/TSC, Cassegrain OE-316(V), Cassegrain
Antenna Pedestal Type	AS-3036/TSC, Dielectric monopod AS-3199/TSC, Dielectric monopod OE-316(V), Dielectric monopod
G/T	Minimum 28 dB with AS-3199/TSC
Antenna Gain	50.2 dB Receive, 51.0 dB Transmit with AS-3199/TSC
EIRP	109 dB with AS-3199/TSC and One HPA
TX Polarization	Right-hand circular
RX Polarization	Left-hand circular
Transmit Frequency	7.9 - 8.4 GHz
Receive Frequency	7.25 - 7.75 GHz
Beacon Carriers	1 Beacon downconverter/receiver
TX RF Carriers	4 Transmit carriers
RX RF Carriers	5 Receive carriers
Upconverter	4 Upconverters
Downconverter	5 Downconverters
Redundancy	Fully redundant, Except antenna
Fault Location	Automatic switching
Frequency Control	1 kHz Steps
Carrier Power Level Control	0-60 dB in 0.1 dB steps
Multiple Access Capability	FDMA
Power Amplifiers	Air Cooled TWTA, 1 kw
Receive Low Noise Amplifiers	Redundant
Prime Power Requirements	120/208 VAC, 50/60 Hz, 3 Phase, 5 Wire
Redundant Power Switchover	Manual
Antenna Tracking System	Manual, Automatic, Memory
Frequency Standard	5 MHz, Redundant Cesium Beams, $\pm$ 4 parts in 10^{-12}

Table 2-7 AN/TSC-86A System Characteristics

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